

Claims

1. Method for cleaning a film-forming apparatus in order to remove a ruthenium-type deposit residing on a constituent member of the film-forming apparatus after said apparatus has been used to form a film comprising ruthenium or solid ruthenium oxide, wherein at least the surface region of the ruthenium-type deposit comprises solid ruthenium oxide, said method being characterized by

converting the aforesaid solid ruthenium oxide into ruthenium metal by bringing the ruthenium-type deposit into contact with a reducing gas that contains a reducing species comprising hydrogen or the hydrogen radical, subsequently converting the ruthenium metal into volatile ruthenium oxide by bringing the ruthenium metal into contact with an oxidizing gas that contains an oxidizing species comprising an oxygenated compound, and removing this volatile ruthenium oxide from the film-forming apparatus.

2. The cleaning method described in Claim 1, characterized in that the reducing gas is composed of inert gas that contains hydrogen at from 1 to 5 volume%.

3. The cleaning method described in Claim 1 or 2, characterized in that contact between the ruthenium-type deposit and the reducing gas is carried out at 80°C to 800°C.

4. Cleaning method according to any of Claims 1-3, characterized in that contact between the ruthenium-type deposit and the reducing gas is carried out at pressures of 0.01-1000 torr.

5 5. Cleaning method according to any of Claims 1-4, characterized in that the aforesaid oxidizing gas comprises ozone-containing oxygen gas originating from an ozone generator.

6. Cleaning method according to any of Claims 1-5, characterized in that contact  
10 between the ruthenium metal and oxidizing gas is carried out at 0°C to 150°C.

7. Cleaning method according to any of Claims 1-6, characterized in that contact between the ruthenium-type deposit and oxidizing gas is carried out after the reducing species has been exhausted off.

15 8. Cleaning method according to any of Claims 1-7, characterized by monitoring the concentration of volatile ruthenium oxide in the volatile ruthenium oxide-containing gas stream flowing out of the film-forming apparatus and stopping the oxidizing gas at the point at which the volatile ruthenium oxide can no  
20 longer be detected in the aforesaid gas stream.

9. Cleaning method according to any of Claims 1-8, characterized in that the volatile ruthenium oxide-containing gas stream flowing out of the film-forming apparatus is heated in order to decompose the volatile ruthenium oxide therein.

5        10. Cleaning method according to any of Claims 1-8, characterized in that the volatile ruthenium oxide-containing gas stream flowing out of the film-forming apparatus is brought into contact with a decomposition catalyst comprising ruthenium metal or a solid ruthenium compound in order to decompose the volatile ruthenium oxide in said gas stream.